Single electrons from semileptonic charm meson decays in 200 GeV pp collisions at PHENIX

Xinhua Li   (UC Riverside)
for the PHENIX Collaboration

Quark Matter 2004 Conference
Jan. 11 – 17, 2004
Oakland, California

Why charm in p+p collisions @ RHIC

Charm production mainly through gluon-gluon fusion and quark-antiquark annihilation. Quark -gluon scattering also involved at higher order.
(R. Vogt, hep-ph/0111271)
Charm measurement intrinsically interesting.

Reference to understand:

- **charm production in heavy ion collisions**
  probe of initial state and state of nuclear medium

- **J/ Ψ suppression in heavy ion collision**
  one of signature of QGP
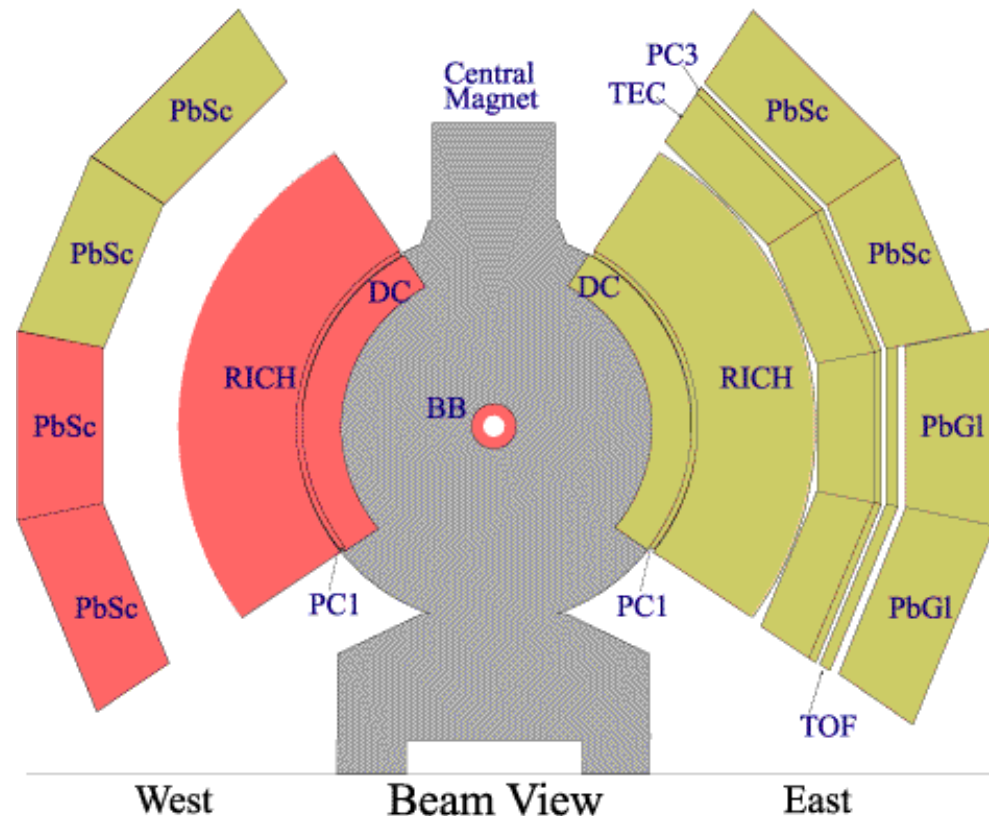
PHENIX in Run2 p+p at 200 GeV

This analysis uses:

15M MiniBias events in $|Z_{vertex}|<25$ cm

465M sampled events by Level1 Trigger

For electron measurements

- BBC: vertex position, trigger
- DC, PC1: tracking

    momentum measurement
- RICH: electron ID
- PC3: charge veto for photon ID
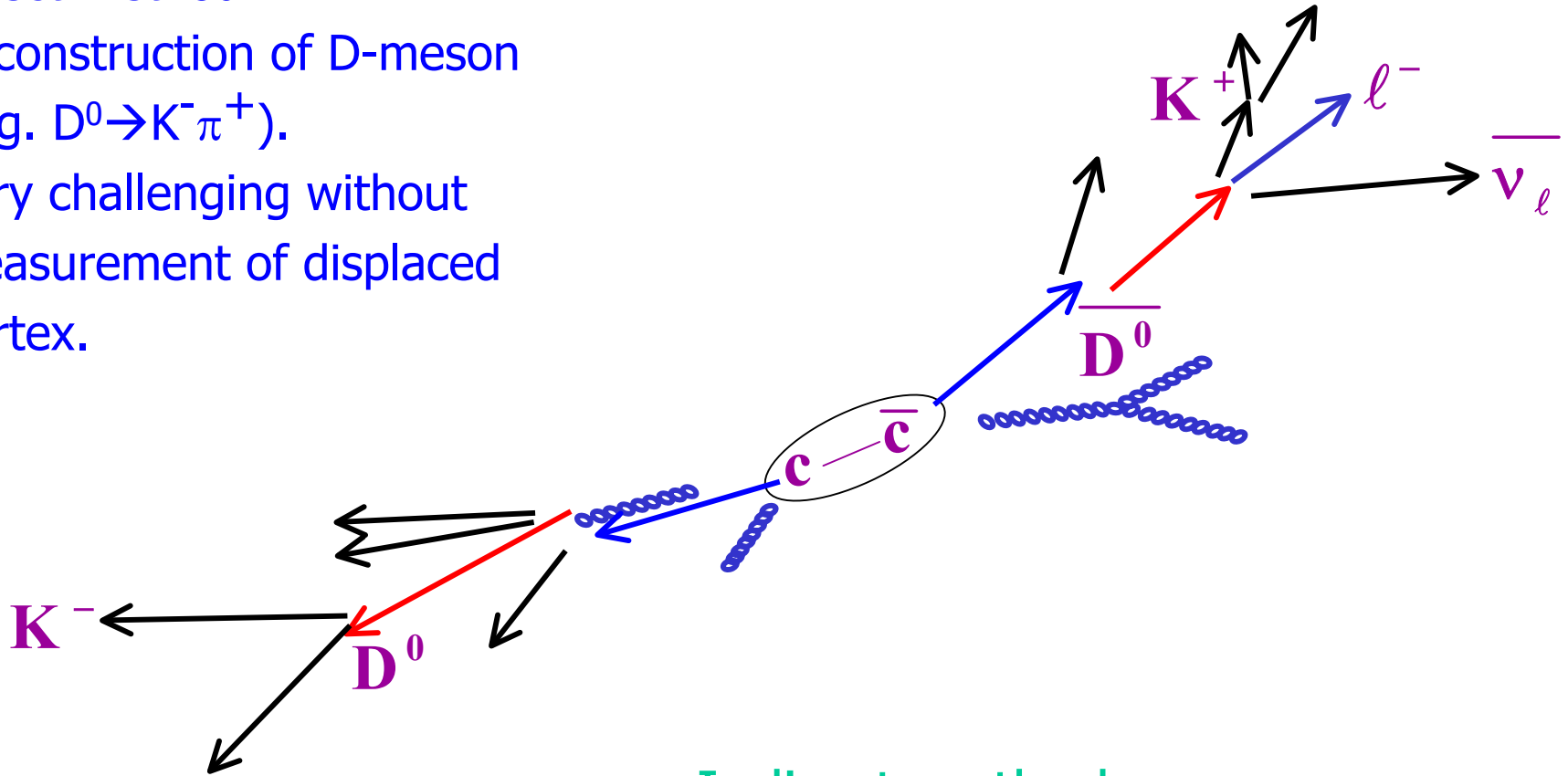- EMCal: electron ID

    energy measurement

How to detect charm

Direct method:
Reconstruction of D-meson
(e.g. $D^0 \rightarrow K^- \pi^+$).
Very challenging without
measurement of displaced
Vertex.

Indirect method:
Measure leptons from semi-leptonic decay of charm mesons.
Used at PHENIX.

Challenging at PHENIX

Charm e/π ~ 3-5x10^{-4} expected in p+p @ 200 GeV

Backgrounds

$\pi^0 \rightarrow e^+e^- \gamma$ **Dalitz: Branching Fraction=1.2%**

$\pi^0 \rightarrow \gamma \gamma$

      $\rightarrow e^+e^-$ **Conversion: comparable to Dalitz**

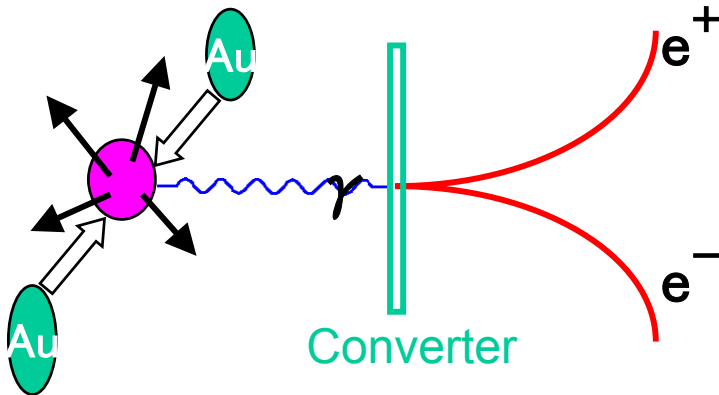$\eta \rightarrow e^+e^- \gamma$

$\eta \rightarrow \gamma \gamma$

      $\rightarrow e^+e^-$ **10-20% of π^0 contribution at high pt**

Others small, e.g. K, ρ, ω, η', ϕ decays

Three approaches at PHENIX

(Talk by S. Kelly in Parallel 2 on Thursday)

Photon converter method:

requires good statistics of dedicated converter run

(Poster Flavor 15)

Cocktail method: needs full knowledge of π^0 spectrum

(Poster Flavor 11)

(e,γ) coincidence: normalization in π^0 spectrum not used

(this poster)

Way to electrons from non-π^0 sources

π^0 **simulation following decay branching fractions**

$B(\pi^0 \rightarrow \gamma\gamma) = 98.8\%$

$B(\pi^0 \rightarrow \gamma e^+ e^-) = 1.2\%$

π^0 **reconstructed from (e,γ) coincidence**

Calculate R=coincidence / electron inclusive

Electrons from non-π^0 sources/electron inclusive

= 1 - R(data)/R(simulation)

Simulation input

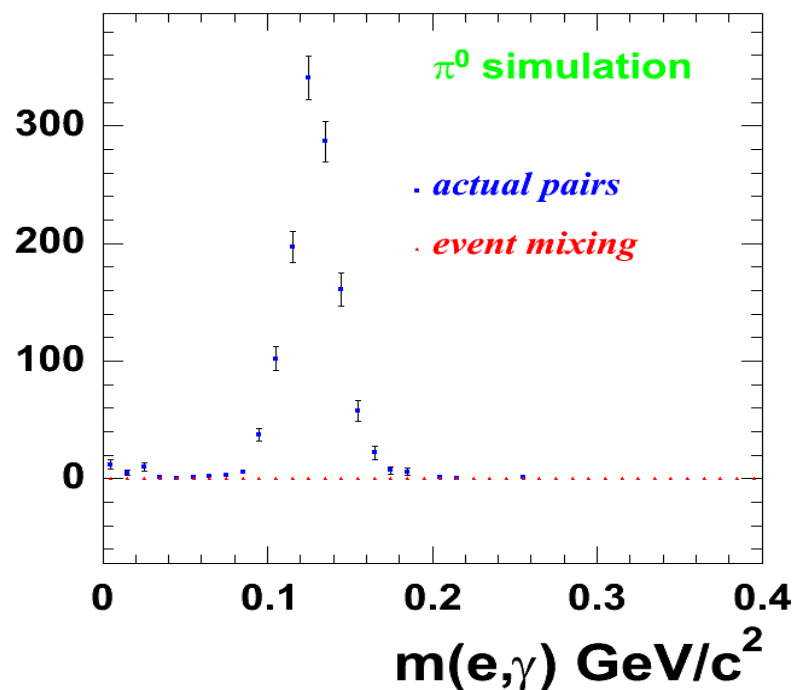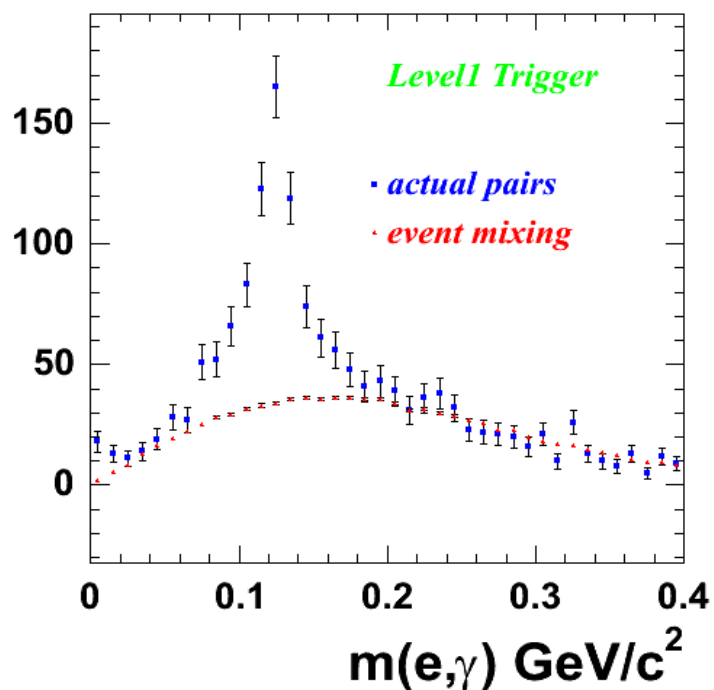**π^0 is well measured at PHENIX for p+p @ 200 GeV**

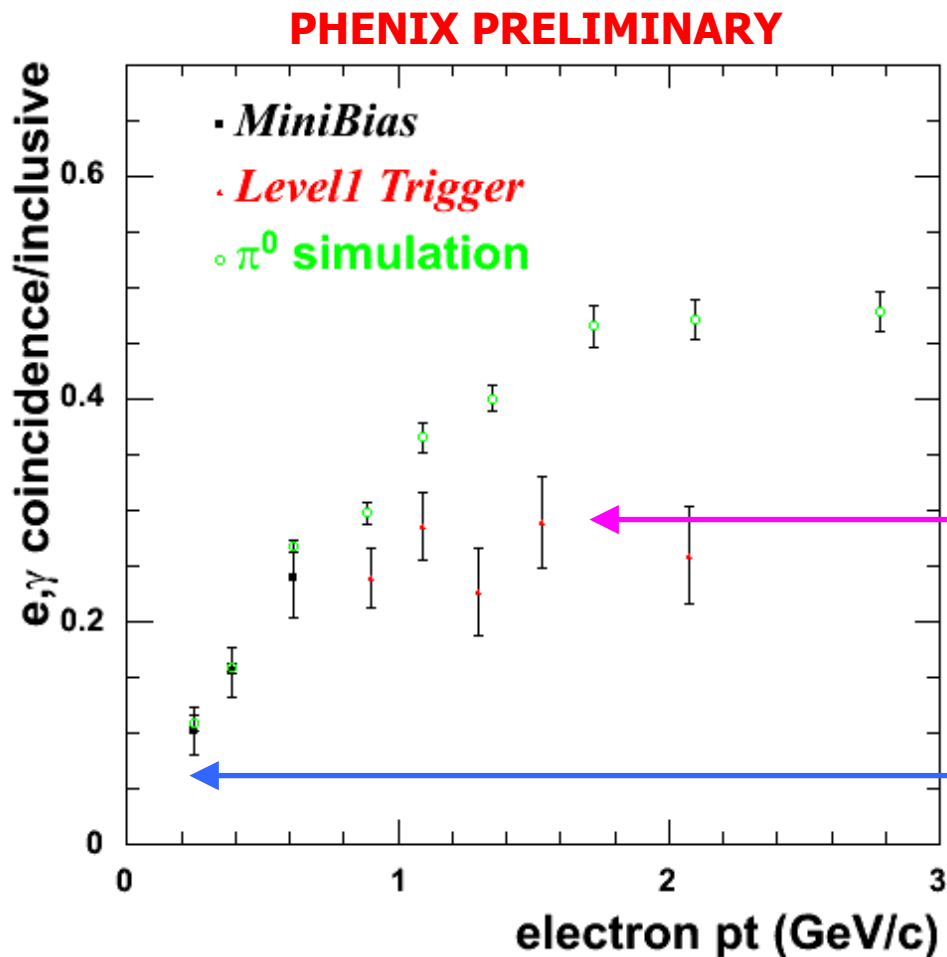*PRL 91, 241803 (2003)*

absolute

normalization (A)

is not used

χ^2 / ndf	6.568 / 14
A	393.4 $\pm$ 137
p0	1.212 $\pm$ 0.1348
n	9.967 $\pm$ 0.313

Fit function: $A/(1+pt/p0)^n$
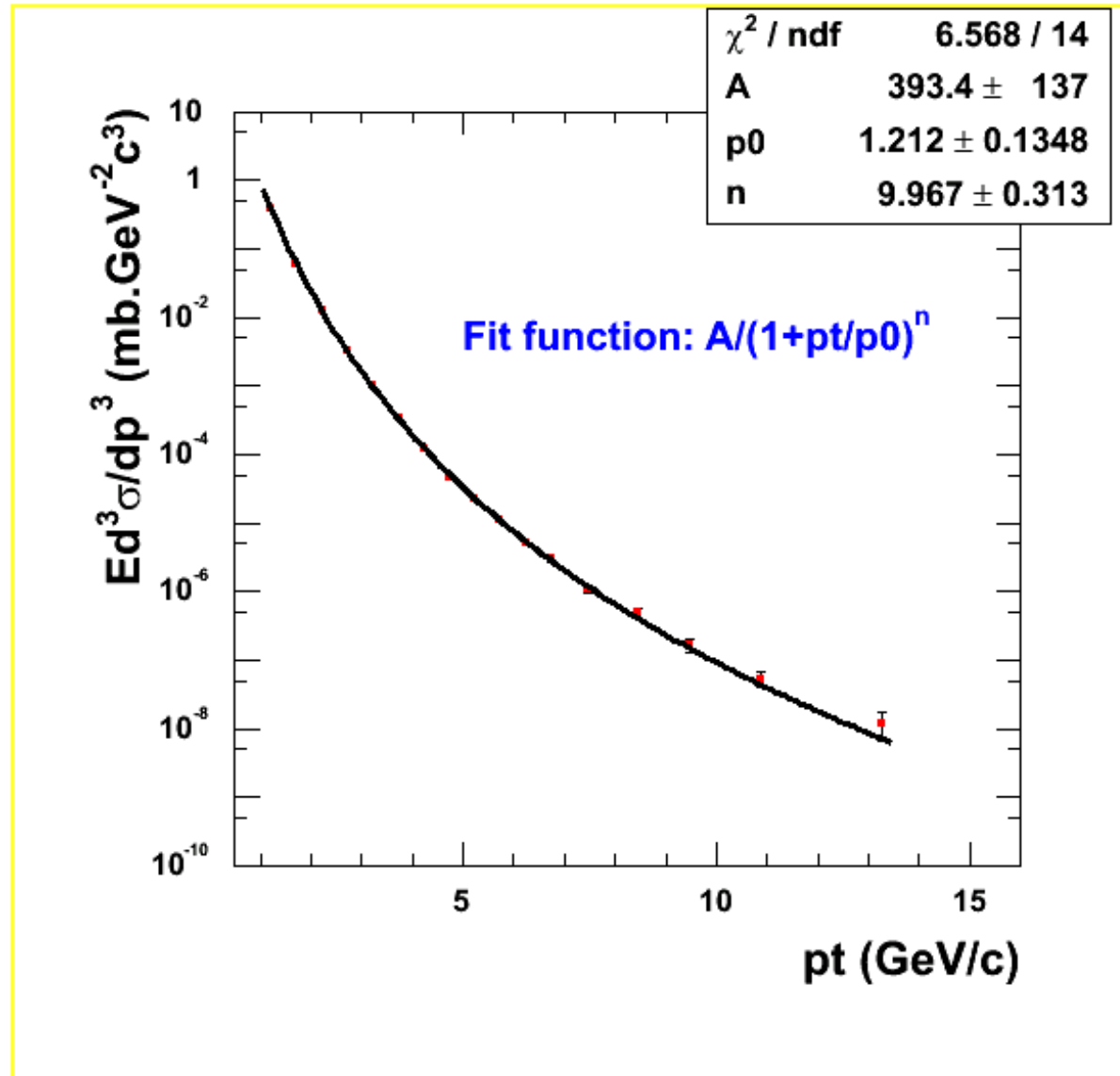
(e, γ) coincidence

Internal/external γ conversion: $\pi^0 \rightarrow \gamma e^+ e^-$

Reconstruct π^0 from (e,γ) coincidence

Rate of (e,γ) coincidence
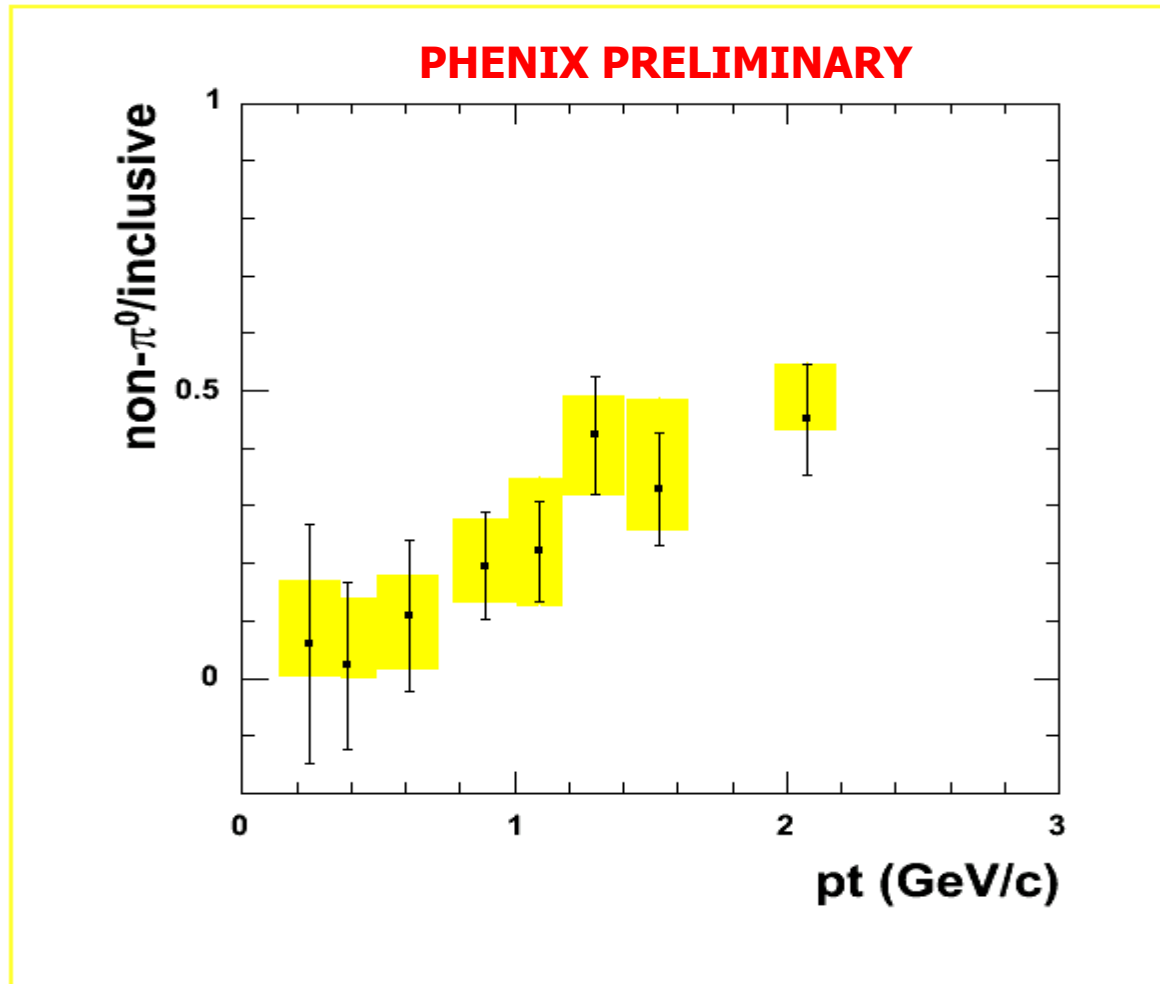

PHENIX PRELIMINARY

- MiniBias
- Level1 Trigger
- π^0 simulation

coincidence increases with p_t due to less bending of electron in magnetic field

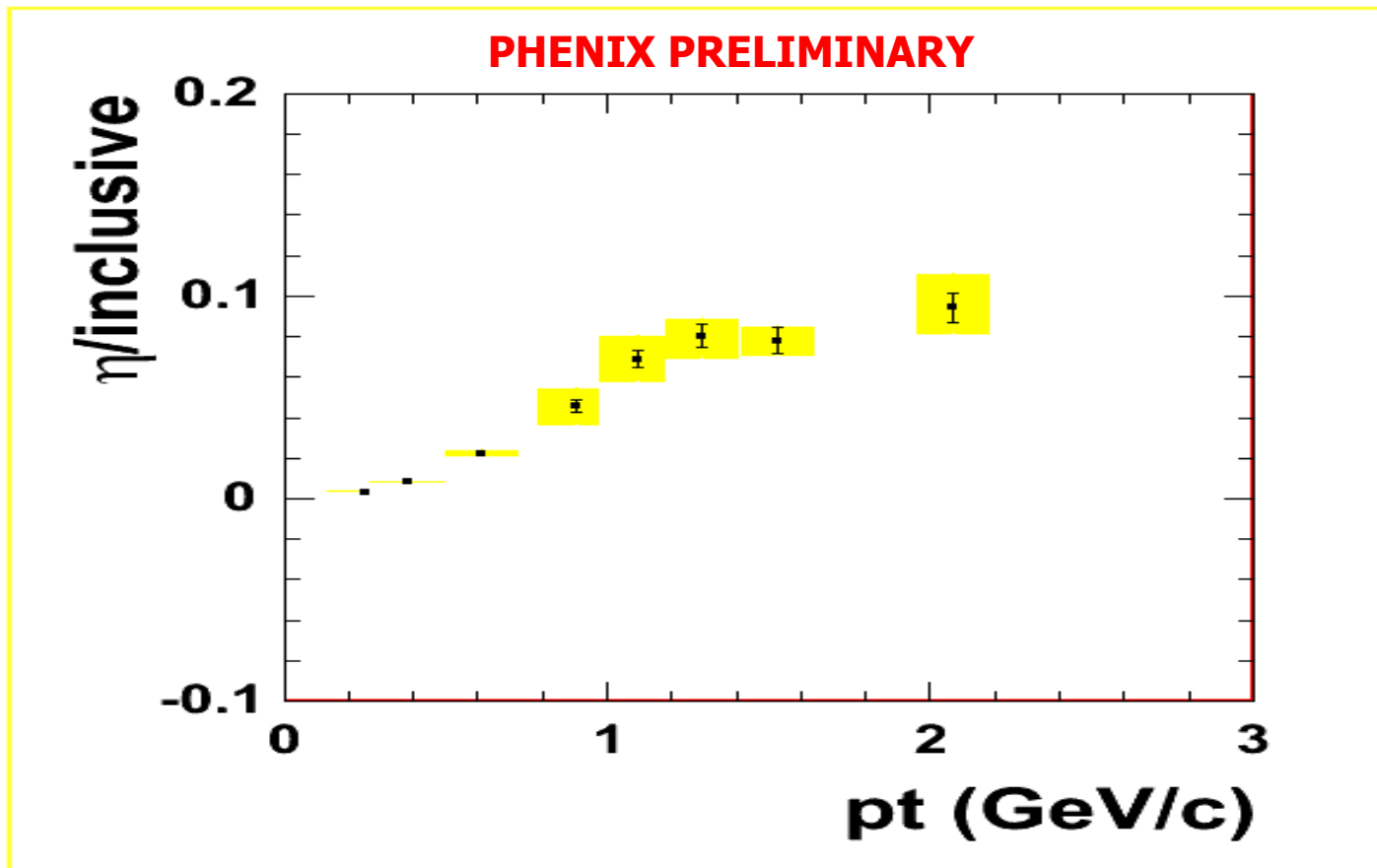no coincidence from charm meson decays **data<simulation at high p_t**

no charm expected to be seen at low p_t data=simulation

Electrons from non-π^0 sources / inclusive in pp collisions at 200 GeV

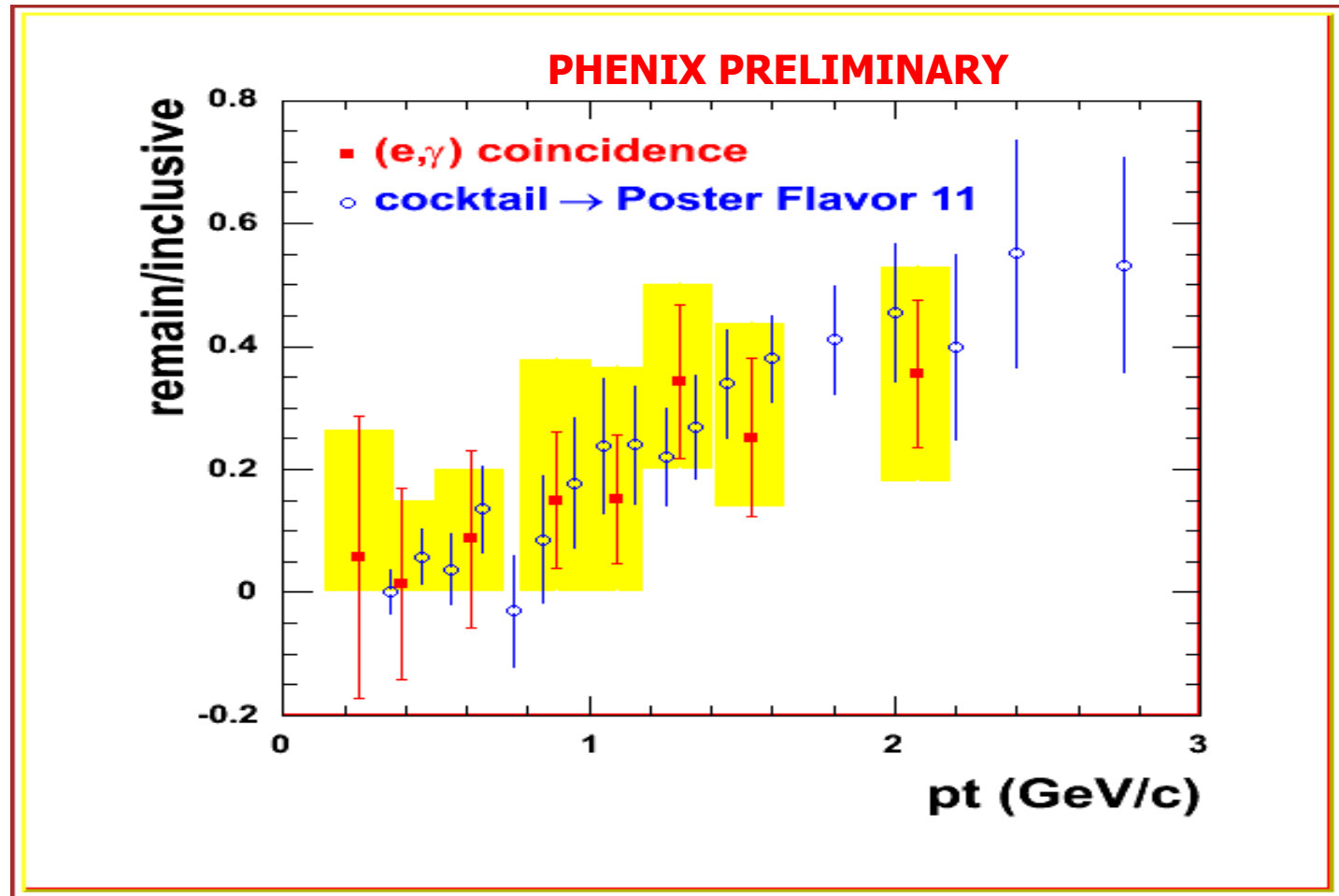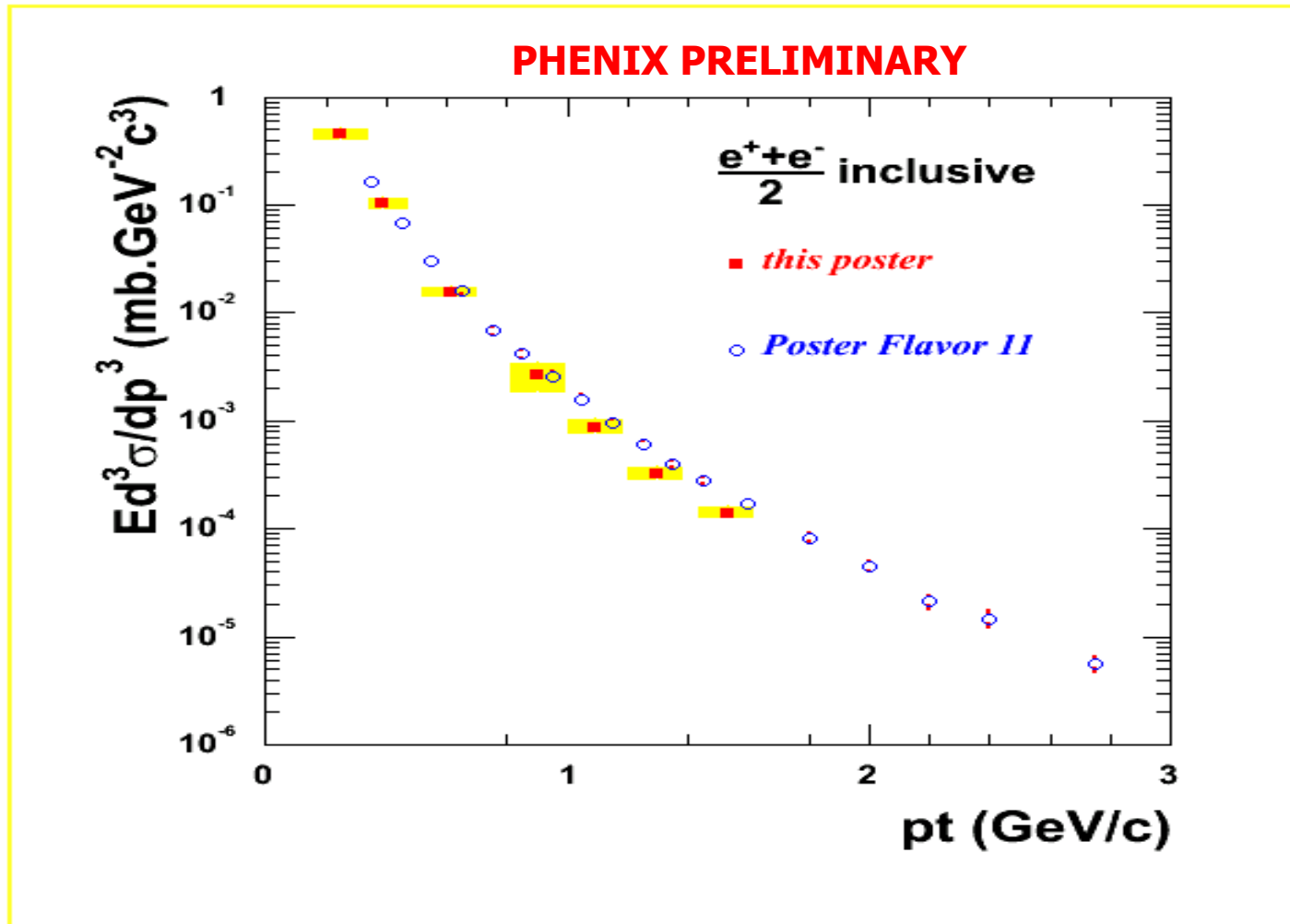# Electrons from η Dalitz and conversions
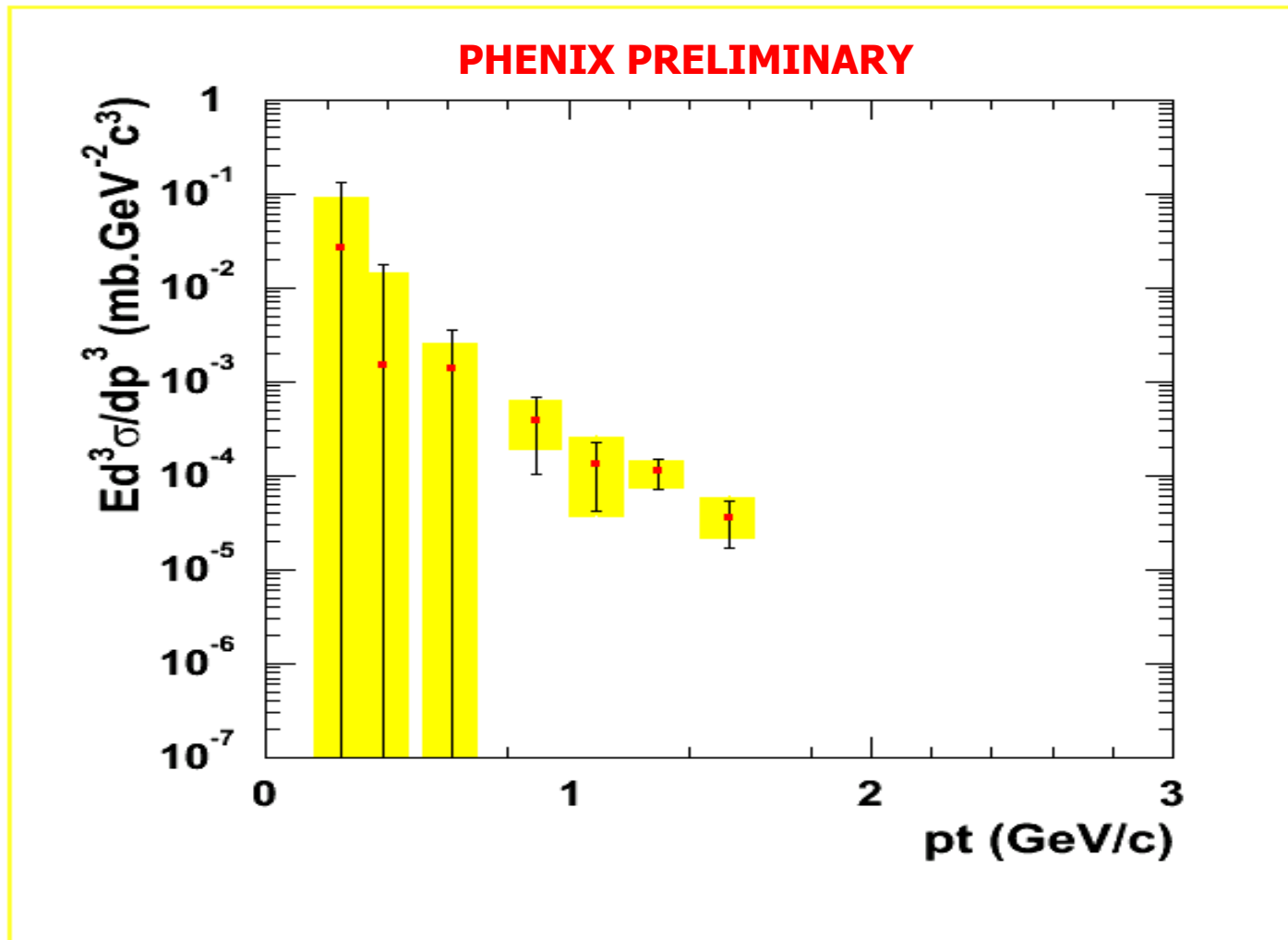
after η subtraction
Ratio of electrons from non-photonic sources over inclusive

Electron inclusive spectrum in pp collisions at 200 GeV

Electrons from non-photonic sources in pp collisions at 200 GeV

PHENIX PRELIMINARY

Summary

Extract electrons from non- π^0 sources by (e,γ) coincidence

Subtract η with PHENIX η spectrum and simulation

New method applicable to dAu, AuAu data analysis

Electron yield from non-photonic sources is measured

K$_{e3}$ contribution is estimated small

Electron signal from charm production is evident

PYTHIA prediction is compared *(Poster Flavor 11)*

Set pp reference for dAu and AuAu